



Appl. No. 10/526,308  
Arndt dated October 10, 2006  
Reply to Office action of July 14, 2006

### **AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions and listings of claims in the application.

#### **Listing of Claims:**

##### **Claims 1-24. (Cancelled)**

**25. (Currently amended)** A fuel injection valve for internal combustion engines, the valve comprising

a valve body (1) having a bore (3) defined on its end toward the combustion chamber of the engine by a conical valve seat (12),

a pistonlike valve needle (5) disposed longitudinally displaceably in the bore (3), the valve needle (5) having a valve sealing face (10) that includes two conical faces (20; 22), on its end toward the combustion chamber the second conical face (22) disposed on the combustion chamber side of the first conical face (20),

an annular groove (25) extending between the conical faces (20; 22), the end of the annular groove (25) facing away from the combustion chamber acting as a sealing edge upon contact of the valve sealing face (10) with the valve seat (12), and

a plurality of recesses (35) embodied on the valve sealing face (10), the recesses (35) hydraulically connecting the annular groove (25) with a portion of the second conical face (22) located on the combustion chamber side of the annular groove (25), wherein the elongated grooves (38) extend beyond the injection openings (11), **wherein the recesses (35) are embodied as a plurality of elongated grooves (38), and the elongated grooves (38) extend beyond the injection openings (14) .**

26. **(Withdrawn)** The fuel injection valve according to claim 25, wherein the recesses (35) are embodied as a roughening of the valve sealing face (10).

27. **(Withdrawn)** The fuel injection valve according to claim 25, wherein the recesses (35) are embodied as polished plane sections (37).

28. **(Previously presented)** The fuel injection valve according to claim 25, wherein the recesses (35) are embodied as a plurality of elongated grooves (38).

29. **(Withdrawn)** The fuel injection valve according to claim 25, wherein the valve sealing face (10) is adjoined toward the combustion chamber by a dead-end volume (40), from which at least one injection opening (14) extends away, and the recesses (35) extend at least as far as a transitional edge (42) defined between the dead-end volume (40) and the valve seat (12).

30. **(Previously presented)** The fuel injection valve according to claim 28, wherein all the elongated grooves (38) begin in the same radial plane perpendicular to the valve needle (5) and intersect the annular groove (25), and extend from there in the direction of the combustion chamber.

31. **(Withdrawn)** The fuel injection valve according to claim 30, wherein the elongated grooves (38) have different lengths.

Claims 32-34. **(Canceled)**

35. **(Previously presented)** The fuel injection valve according to claim 28, wherein the elongated grooves (38) have a width (b) of 5  $\mu\text{m}$  to 50  $\mu\text{m}$ .

36. **(Currently amended)** The fuel injection valve according to claim 28, wherein the elongated grooves (38) are embodied rectilinearly and extend along the **jacket lines of the** second conical face (22).

37. **(Withdrawn - Currently amended)** The fuel injection valve according to claim 28, wherein the elongated grooves (38) are rectilinear and are inclined relative to the **jacket lines of the** second conical face (22).

38. **(Previously presented)** The fuel injection valve according to claim 28, wherein the depth (t) of the elongated grooves (38) is from 1 to 10 times their width (b).

39. **(Withdrawn)** The fuel injection valve according to claim 28, wherein the width (b) of the elongated grooves (38) decreases from their end facing away from the combustion chamber toward the combustion chamber.

40. **(Withdrawn)** The fuel injection valve according to claim 28, wherein the elongated grooves (38) are curved in a generally S shape.

41. **(Withdrawn)** The fuel injection valve according to claim 28, wherein the elongated grooves (38) extend as far as the end toward the combustion chamber of the valve needle (5).

42. **(Withdrawn)** A fuel injection valve for internal combustion engines, the valve comprising

a valve body (1) having a bore (3) defined on its end toward the combustion chamber of the engine by a conical valve seat (12),

a pistonlike valve needle (5) disposed longitudinally displaceably in the bore (3), the valve needle (5) having a valve sealing face (10) that includes two conical faces (20; 22) on its end toward the combustion chamber, the second conical face (22) being disposed on the combustion chamber side of the first conical face (20),

an annular groove (25) extending between the conical faces (20; 22), the end of the annular groove (25) facing away from the combustion chamber, acting as a sealing edge upon contact of the valve sealing face (10) with the valve seat (12), and

a plurality of recesses (35) embodied on the valve seat (12), the recesses (35) hydraulically connecting the annular groove (25) with a portion of the valve seat (12) located on the combustion chamber side of the annular groove (25).

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43. **(Withdrawn)** The fuel injection valve according to claim 42, wherein the recesses (35) are embodied as rectilinear grooves.

44. **(Withdrawn)** The fuel injection valve according to claim 43, further comprising injection openings (14) extending away from the valve seat (12), the rectilinear grooves extending as far as the level of these injection openings (14).

45. **(Withdrawn)** The fuel injection valve according to claim 44, wherein the rectilinear grooves are located at a position between the injection openings (14).

46. **(Withdrawn)** The fuel injection valve according to claim 44, wherein the rectilinear grooves extend beyond the injection openings (14).

47. **(Withdrawn)** The fuel injection valve according to claim 42, further comprising a dead end volume (40) adjoining the valve seat (12) toward the combustion chamber, a plurality of injection openings (14) extending from the dead end volume (40), and rectilinear grooves embodied in the valve seat (12), the rectilinear grooves extending from the annular groove (25) to a transitional edge (42) of the valve seat (12) with the dead-end volume (40).

48. **(Previously presented)** The fuel injection valve according to claim 25, wherein the recesses (35; 38) are produced by a laser process.

49. **(Withdrawn)** The fuel injection valve according to claim 42, wherein the recesses (35; 38) are produced by a laser process.

50. **(New)** A fuel injection valve for internal combustion engines, the valve comprising  
a valve body (1) having a bore (3) defined on its end toward the combustion chamber  
of the engine by a conical valve seat (12),  
a pistonlike valve needle (5) disposed longitudinally displaceably in the bore (3), the  
valve needle (5) having a valve sealing face (10) that includes two conical faces (20; 22), on  
its end toward the combustion chamber the second conical face (22) disposed on the  
combustion chamber side of the first conical face (20),  
an annular groove (25) extending between the conical faces (20; 22), the end of the  
annular groove (25) facing away from the combustion chamber acting as a sealing edge upon  
contact of the valve sealing face (10) with the valve seat (12), and  
a plurality of recesses (35) embodied on the valve sealing face (10), the recesses (35)  
hydraulically connecting the annular groove (25) with a portion of the second conical face  
(22) located on the combustion chamber side of the annular groove (25),  
wherein the recesses (35) are embodied as a plurality of elongated grooves (38),  
wherein the end of the elongated grooves (38) facing away from the combustion  
chamber is located inside the annular groove (25).

51. (New) A fuel injection valve for internal combustion engines, the valve comprising  
a valve body (1) having a bore (3) defined on its end toward the combustion chamber  
of the engine by a conical valve seat (12),

a pistonlike valve needle (5) disposed longitudinally displaceably in the bore (3), the  
valve needle (5) having a valve sealing face (10) that includes two conical faces (20; 22), on  
its end toward the combustion chamber the second conical face (22) disposed on the  
combustion chamber side of the first conical face (20),

an annular groove (25) extending between the conical faces (20; 22), the end of the  
annular groove (25) facing away from the combustion chamber acting as a sealing edge upon  
contact of the valve sealing face (10) with the valve seat (12), and

a plurality of recesses (35) embodied on the valve sealing face (10), the recesses (35)  
hydraulically connecting the annular groove (25) with a portion of the second conical face  
(22) located on the combustion chamber side of the annular groove (25),

wherein the recesses (35) are embodied as a plurality of elongated grooves (38),  
wherein the elongated grooves (38) are microscopic grooves, whose depth (t) is less than 50  
 $\mu\text{m}$ .